Session No. 784

Challenges Posed by RF Radiation Exposure from Wireless Antenna Systems

Richard J. Burnheimer, BA, MBA
Executive Vice President
Risk Management and Environmental, Health & Safety
RF CHECK Inc.
San Diego, CA

Introduction

Our nation's favorite form of communication depends on radio-frequency radiation-producing wireless antennas. The popularity of this technology is obvious to the end-user with the abundance of smart phones, laptops, tablets and other devices in use today. However, what is not apparent to most are the massive networks of wireless antennas that tether all of us together *instantly*.

The RF radiation produced from just one of these wireless antennas can be several hundred times that of a cell phone, and is recognized by science and the federal government as being harmful to humans. By the very ubiquitous nature of wireless antennas, workers are routinely compelled to work in front of, and in close proximity to these devices.

In addition to the harm to human beings, various entities have financial liability on this issue, which emanates from their multiple roles as FCC licensee, site owner, site operator, lessor, lessee, employer, employer of third-party contractors/subcontractors and their employees. In conjunction, every wireless antenna has the potential to create liability. It is estimated that financial exposure could exceed $124 billion.[1]

Most entities fail to associate the intricacies of wireless communications with human RF radiation over-exposure and its potentially catastrophic financial consequences. This issue most often falls under the category of "out of sight, out of mind," and most likely will be ignored until the trial lawyers become involved. At that point, it will be too late to avoid long-term litigation and substantial monetary losses.

[1] *RM/Insight* Volume 12 Number 1. Are Radio Waves Injuring Us? Page 25.

The Rapid Growth of Wireless

Cell phone use has become an integral part of everyday life in this nation. The wireless telecommunications industry enjoys tremendous popularity, if not dependence upon it. Consumer demand continues to grow, unabated, for existing and new technologies, products and services.

The growth of the industry has been astronomical. In 1997, there were 48.7 million wireless subscribers in the United States. Now there are over 320 million connected devices representing more than 100% of the total U.S. population.[2]

At the inception of the wireless industry, only a limited number of antenna systems existed across our nation. These antennas were mainly located along freeway corridors within major metro areas. Most often, they were perched atop poles surrounded by locked fencing and access was only granted to RF-trained technicians. However, in order to supply consumers with its widely popular products and services, the wireless industry has expanded its wireless networks, resulting in a dramatic increase in of the number of deployed wireless network components, such as base stations and antennas. Today wireless antennas are everywhere – on rooftops, the sides of buildings, utility poles, light standards and hidden entirely within the structures of buildings.

In 1997, there were 38,000 commercial cell sites across the United States.[3] Today, the wireless industry's advocacy group, CTIA, states that there are more than 285,000 cell sites throughout the country, many of which host multiple wireless antennas, pulling the total estimated number of commercial and governmental wireless antenna systems to nearly 600,000 and this number is projected to exceed one million in the not-too-distant future.

RF Radiation Health and Safety Hazard

These wireless transmission sites come with an environmental, health and safety hazard: RF radiation. The ability to ensure workers' health and safety has become far more difficult since the time the Federal Communications Commission (FCC) established RF radiation human exposure limits and standards. Strategies and methodologies to protect workers have been outstripped and rendered obsolete by the astonishing, rapid proliferation of wireless networks.

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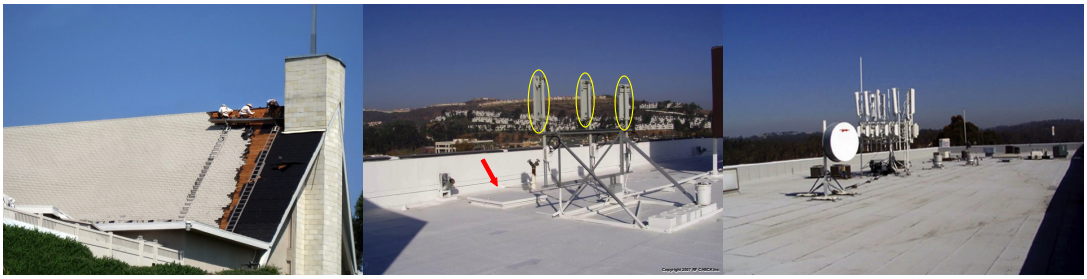
[2] CTIA The Wireless Association (retrieved March 13, 2013) (http://www.ctia.org/consumer_info/service/index.cfm/AID/10323).

[3] (CTIA)

RF radiation transmitting antennas are omnipresent – no longer limited to isolated, remote towers. They are located on rooftops, sides of buildings, utility poles, flagpoles, lighting standards, camouflaged and concealed entirely within buildings. Workers that are compelled to work in proximity to RF radiation transmitters are no longer limited to the wireless industry's RF trained technicians with protective gear and equipment. Rather, roofers, electricians, carpenters, maintenance personnel, HVAC technicians, painters, first-responders and a multitude of other trades are routinely required to work near RF radiation transmitting antennas despite being denied RF safety training and even information relative to the existence and location of RF radiation hazards.



Practical Challenges

Workers are routinely exposed to excessive levels of RF radiation because no effective, comprehensive RF radiation safety system is currently in operation. A number of practical challenges render it impossible for wireless service providers or the wireless industry alone to ensure the protection of all workers and the welfare of their families. These practical challenges include the following:

- The impossibility or impracticality of wireless service providers to have continuous (24/7) knowledge and control of all activities at antenna sites;
- Mandated use of "stealth" antennas that prevent workers from identifying the existence and location of RF radiation hazards at work sites;
- Mandated collocation of RF radiation transmitting antennas that results in increased aggregate RF radiation emissions, more RF radiation hazards at a site and coordinating power-down among multiple service providers more complex;
- Locks and restricted access may protect service providers' and property owners' physical assets from theft and vandalism, but they do not protect workers who are compelled to enter restricted areas to fulfill their job responsibilities;
- Signage is often missing, mislabeled, unintelligible and outdated (particularly in an industry where mergers and acquisitions are common);
- The practice of outsourcing work to third-parties is an increasingly common means to cut operational costs;
- Third-party workers are generally not provided RF radiation training and are, therefore, largely uninformed of RF radiation emissions and the risks they pose;
- Pole attachments (potentially the fastest and least expensive method of expanding networks) are pursued in the hurry-up world of fierce competition that does not always include careful engineering, permission to attach facilities, code compliant construction and maintenance;
- No national uniform standards exist for mapping and facility documentation;

- Thorough, ongoing inspections and audits are not consistently and routinely undertaken;
- No current solution includes the participation of all required stakeholders (i.e., commercial service providers, property owners hosting antenna sites, employers, local governments and the workers, themselves); and
- Current RF radiation health and safety methodologies lack independence, transparency and validation.

This list is merely illustrative. Numerous other practical considerations giving rise to this national worker safety issue certainly exist. Let's take a closer look at a few of today's safety measures and why they no longer meet the requirements of a viable safety solution.

Signage

No specific FCC regulations exist that impose signage requirements or prescribe the content of RF signs. The FCC does, however, recommend RF signs and fencing as means of controlling RF exposure areas. OSHA's "General Duty" provision (i.e., to provide a safe work environment) is often cited as requiring RF hazard signs.

We have identified a number of shortcomings (i.e., the practical challenges) with signs as a RF safety device such as the fact that they are missing, misplaced, ambiguous, vague, and outdated in the wake of mergers, acquisitions, equipment upgrades or other changes at an antenna site (including the addition of collocated antennas). In fact, it is a common practice among wireless service providers to power-down antennas to protect their employees and to require them to wear protective gear and pocket protection monitors "since they have no idea how well signs on rooftops depict the actual situation and they have no control or knowledge of the rationale for their placement."[4] In other words, the wireless industry, itself, has no confidence that signs provide any protection.

RF signage is not part of the solution; it is part of the problem today.

Limitations of Pocket Protection Monitors

The purpose of a radio frequency (RF) radiation pocket protection monitor is to indicate when the wearer is being exposed to RF radiation fields that exceed the FCC's maximum permissible exposure (MPE) limits for an occupational/controlled RF environment.[5] Workers that use monitors and RF protective gear must be trained to work in RF environments to satisfy the FCC's criteria for being fully aware of the existence of RF hazards and possessing the ability to control their exposure to RF radiation.[6] Third-party workers such as roofers, HVAC technicians, maintenance workers, painters and members of similar trades are not the proper or intended users of monitors. While it may be fairly simple to control access to a tower, it is difficult, if not impossible, to control access to an entire roof where tradesmen are compelled to work in close proximity to RF transmitting antennas."[7]

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[4] Narda Safety Test Solutions, *A Practical Guide for Establishing an RF Safety Program*, page 12.
[5] *Above Ground Level (AGL)* magazine, April 2006; Vol. 3, No.2; RF Hazard Protection Equipment, pages 22.
[6] (*Above Ground Level* 22-23)
[7] *Radio Business Report, supra, page 21.*

Monitors provide warnings whenever and wherever people are already in danger from RF radiation fields. As a result, it is akin to a car's dashboard light that alerts when the engine temperature is already too hot. It is unrealistic, if not impractical, that all workers (e.g., painters, roofers and maintenance workers) will be provided monitors. The requisite training to use a monitor would require time, money and effort that neither a worker nor his employer may be willing to spend. A worker must always be aware of a multitude of site conditions, their potential impact upon the RF environment and know where the danger is even with a monitor. Again, the expectation that a third-party worker can, and will, appreciate the existence of all conditions, their effect on RF emissions and the accuracy of RF monitors is unrealistic.

RF personal protection monitors do not pose as a realistic means to protect the ordinary worker. The manufacturers do not intend them to serve that purpose. Even if monitors were to be used by third-party workers, they could create a false sense of security that creates an even greater risk of RF radiation over-exposure.

FCC RF Radiation Human Exposure Limits Are Based on Long-Standing Science

Excessive exposure to radio frequency (RF) radiation is hazardous to human health.[8] For this reason, the IEEE developed limits for human exposure to RF radiation that have been widely adopted or influential around the world.[9]

The IEEE standard represents a consensus of scientific opinion about safe levels of exposure to RF radiation, and its scientific rationale is consistent with conclusions of numerous expert groups and health agencies throughout the world.

The present focus is on the process that led to the IEEE C95.1 standard covering the frequency range 3 kHz – 300 GHz, which includes the RF spectrum. Other major exposure limits, in particular the widely-referenced guidelines of the International Commission on Non-ionizing Radiation Protection (ICNIRP) have a similar rationale but were developed using different processes.[10]

The origin of the IEEE C95.1 standard traces back to 1960 when the American Standards Association (now ANSI, a clearing house for standards of all sorts) approved the Radiation Hazards Standards Project C95 and established a committee charged with developing RF radiation exposure standards.[11] The first C95 standard, USASI C95.1-1966, was published in 1966, and with major revisions was republished in 1974 and 1982. In 1989, the IEEE assumed sponsorship of the committee, which became IEEE Standards Coordinating Committee 28 (SCC-

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[8] COMAR Reports, "COMAR Technical Information Statement: the IEE exposure limits for radiofrequency and microwave energy," *IEEE Engineering in Medicine and Biology Magazine*, March/April 2005, at page 114; http://www.ewh.ieee.org/soc/embs/comar/standardsTIS.pdf.

[9] (COMAR Reports)

[10] IEEE C95.1-1991, Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz, (1999 edition).

[11] J.M. Osepchuk and R.C. Petersen, "Safety standards for electromagnetic fields," *IEEE Microwave Magazine*, vol.2, no. 2, pages 57-69, June 2001.

28). In 2001, SCC-28 adopted the name IEEE International Committee on Electromagnetic Safety (ICES).[12]

Under both IEEE and ANSI bylaws, standards (of all sorts) must be periodically updated and revised. The latest RF standard, IEEE C95.1 was approved by the IEEE Standards Board in 1991 and by ANSI in 1992. This standard was reaffirmed in 1997 and a supplement published in 1999.[13]

Thus, the present IEEE exposure guidelines that have been adopted by the FCC have a lineage that extends for nearly half a century.[14]

When considering possible hazards of RF radiation, it is important to distinguish between levels of fields outside the body (the exposure) and field levels or absorbed energy within body tissues (the dose). The exposure is measured in terms of the electromagnetic field strength or power density on the body. The dose depends on the exposure, as well as on the body geometry, size, its orientation with respect to the external field and other factors.

Between approximately 100 kHz and 10 GHz, the specific absorption rate (SAR) is the dosimetric quantity that correlates best with reported biological effects of RF energy. The whole-body-averaged SAR is the total power absorbed by the individual subject (in watts) divided by the body mass (kilograms), and is expressed in units of W/kg.

For localized exposures to parts of the body, for example the head, a more useful measure is often the partial body exposure, which is the power absorbed per unit mass in a localized region of tissue, also expressed in W/kg.

As with exposure limits too many hazardous substances, the RF safety standards in the United States (and most countries) have two tiers, which vary in definition but correspond approximately to limits for occupational groups and the general public. In the IEEE standard, adopted by the FCC, two tiers are defined as applying to exposures in controlled (occupational) and uncontrolled (general public) environments.[15]

The IEEE C95.1-1991 standard was based on a comprehensive review of the scientific literature, covering all reliable studies that reported biological effects of RF/microwave energy. This task, and the development of a draft standard, was accomplished by a 125-member subcommittee (Subcommittee 4) of the IEEE Standards Coordinating Committee 28.[16]

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[12] COMAR Reports, supra.
[13] (COMAR Reports)
[14] (COMAR Reports)
[15] (COMAR Reports)
[16] (COMAR Reports) The composition of the subcommittee by affiliation was Research (University: 29.6%, Nonprofit: 6.4%, Military: 12% and Government: 24%), Industry (9.6%), Industry-Consulting (3.2%), General Public and Independent Consultants (11.2%). The composition by principal discipline was Physical Sciences (physics, biophysics, engineering, etc.: 32.8%), Life Sciences (biology, genetics, etc.: 43.2%), Medicine (physicians: 9.6%), Radiology/Pharmacology/Toxicology (3.2%) and Others (law, medical history, safety, etc.: 11.2%).

The scientific literature related to biological effects of RF radiation is highly diverse, both in terms of scientific quality and in terms of relevance to possible health and safety risks to humans. The review process examined only studies that met selection criteria that included adequate dosimetry and experimental design and independent confirmation of reported effects. Studies that were not published in the peer reviewed scientific literature and those that were inadequately described to permit critical analysis were excluded from consideration.[17]

Based on its review, the subcommittee concluded, "Disruption of food-motivated learned behavior in laboratory animals is the most sensitive biological response that is both well confirmed and predictive of hazard." This effect, known as "behavioral disruption," has been observed in laboratory animals ranging from rodents to monkeys exposed to RF fields at frequencies ranging from 225 MHz to 5.8 GHz.[18] Depending on the animal species and RF frequency, the exposure needed to produce behavioral disruption varied widely, from about 100 to 1400 W/m².[19]

The behavioral disruption suffered by the test subjects following their exposure to RF radiation established the causal link between the RF exposure and behavioral and cognitive injuries that include reduced brain function, memory loss, mood disorders, sleep disorders and psychological ailments such as depression.

From its review of scientific studies, the subcommittee chose a value of 4 W/kg for the whole-body-averaged SAR as the threshold for behavioral disruption in animals. The basic restrictions on whole body SAR are 0.4 W/kg for controlled environments and 0.08 W/kg for uncontrolled environments. Other limits were developed for partial body exposure and for fields of unusual characteristics, such as very short pulses of high intensity.[20]

The draft of the 1991 IEEE standard underwent a long and rigorous process before finally be approved by the IEEE. After being approved by the subcommittee, the draft standard was moved to the main committee for approval using the same balloting procedure, and then to the IEEE Standards Board for final approval. Final approval required 75% affirmative votes of those submitting ballots. The final approved IEEE standard was then forwarded to ANSI, which required a period of public comment and response. In 1992, ANSI adopted the standard as an American National Standard that the FCC adopted in its RF radiation human exposure limits and related regulations in 1996.[21]

The Next Steps

Workers who are required to perform their jobs in close proximity to radiofrequency radiation transmitters are no longer just trained industry technicians protected by the latest gear and equipment. Rather, they are now roofers, electricians, carpenters, maintenance personnel, HVAC

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[17] (COMAR Reports)
[18] "The Cognitive and Behavioral Effects of Microwave Exposure," *http://www3.interscience.wiley.com/cgi-bin/fulltext/106565260/PDFSTART (at page16)*.
[19] (The Cognitive and Behavioral Effects of Microwave Exposure16-21; also COMAR Reports, supra)
[20] (The Cognitive and Behavioral Effects of Microwave Exposure16-21; also COMAR Reports, supra)
[21] Welcome to IEEE standards development online; http://standards.ieee.org/resources/developments/index.html

technicians, painters, first-responders and many others. Ultimately, these unsuspecting workers are regularly exposed to excessive levels of RF radiation because there is no comprehensive radiation safety system currently in operation and given the health hazards and potential liabilities involved, the time for complacency and neglect to the safety of workers has passed. A viable radiofrequency safety program must be implemented.

First and foremost, education is crucial. Everyone at risk should be taught the exposure regulations and hazards associated with radiofrequency emissions. Workers must be given site-specific safety plans that combine with an updated database of antenna locations to establish a standardized national radiofrequency safety protocol that includes the participation of all required stakeholders (i.e., FCC licensees, property owners hosting antenna sites, employers, local governments and the workers themselves). A national, accessible registry of wireless antenna systems that identifies location and exposure zones throughout North America is being created and will significantly reduce the financial liability of all stakeholders. The registry will be similar to the “Call 811 before you dig” underground utility locator service and constitute an electronic repository of documentary evidence of use and compliance with radiofrequency safety.

For this to occur, impacted entities must also demand the deployment of a meaningful loss-control tool to continue to protect their employees, their contractors' employees and their own financial interests. The risk is here, it is imminent and unless a loss-control tool is implemented to protect them, an inevitable tidal wave of litigation with significant financial consequences is assured.

RF CHECK, Inc. (www.rfcheck.com) has established a new comprehensive RF radiation safety protocol for all (governmental and commercial) wireless antenna systems across the nation. The patented RF safety system will supply all workers, contractors, site owners, municipalities, insurers, service providers, and other stakeholders within the wireless ecosystem the necessary information to educate and protect themselves from either the physical or financial harms of RF radiation. This powerful RF safety and loss control tool will be furnished to all at no cost and is monetized by an insignificant fee on wireless subscribers’ monthly statements.